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# THE UNITED STATES OF AMERICA

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**April 01, 2004**

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PTO/SB/16 (10-01)
Approved for use through 10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE



# PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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## TITLE OF THE INVENTION (500 characters max)

PROCESS FOR SEALING PLATES IN A FUEL CELL

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## ENCLOSED APPLICATION PARTS (check all that apply)

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☐ Application Data Sheet. See 37 CFR 1.76

## METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees

☑ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 04-1928

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

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Respectfully submitted,

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REGISTRATION NO. (if appropriate) 36,509

Docket Number: DC8510 US PRV

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## USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

# PROVISIONAL APPLICATION COVER SHEET
## Additional Page

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| Docket Number | DC8510 US PRV |
|---|---|

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Number 2 of 2

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## TITLE

# PROCESS FOR SEALING PLATES IN A FUEL CELL

## FIELD OF THE INVENTION

The present invention relates to a process for sealing coolant plates in a fuel cell, and in particular to a process for sealing two coolant plates together or a coolant plate to a bipolar plate using vibration and resistance welding techniques.

## BACKGROUND OF THE INVENTION

Polymer electrolyte membrane fuel cells (PEMFC) comprise a membrane electrode assembly (MEA) disposed between two separator plates commonly known as bi-polar plates. Within the MEA lies a pair of fluid distribution layers, commonly referred to as gas diffusion layers (GDL) and an ion exchange membrane. At least a portion of either the ion exchange membrane or gas diffusion layers is coated with noble metal catalysts. The ion exchange membrane is placed between the GDL and compressed to form the MEA. The bi-polar plates provide support to the MEA and act as a barrier, preventing mixing of fuel and oxidant within adjacent fuel cells. The bi-polar plates also act as current collectors. The bi-polar plates may include flow field channels that assist with transport of liquids and gases within the fuel cell.

A fuel cell typically functions as a series of connected fuel cells, called a fuel cell stack. The fuel cell stack produces a substantial amount of heat in addition to producing electricity through the reaction of fuel and oxidant. Heat must be removed from the fuel cell stack in order to operate the fuel cell stack isothermally. As a result, separator plates that assist with the transport of coolant to and from the fuel cell ("coolant plates") are used. The coolant plates may include flow field channels, grooves or passageways that are used to transport coolant within the fuel cell stack to remove excess heat and maintain the fuel cell stack at operating temperature. The coolant plates keep the coolant fluid separated from the bi-polar plates.

A fuel cell stack is generally provided with holes, commonly known as manifold holes, to transport reactants, products, and coolant to and from the fuel cell stack. The bi-polar plates and the coolant plates of the fuel cell stack are each connected by at least one channel to the inlet and outlet manifold holes. Through these channels, the bi-polar plates transport reactants and products to and from the GDL of the MEA, and the channels of the coolant plates transport coolant.

As a result of the transfer of liquids and gas to and from the fuel cells within the fuel cell stack, proper sealing at the outer perimeter or periphery of channels and manifold holes, which contain liquids and gas, is crucial. In general, the bi-polar plates and the coolant plates are provided with seals to prevent the liquid or gases from leaking and to prevent inter-mixing of gases (fuel and oxidant) and coolant in the manifold areas. Gaskets are applied along the periphery of the bi-polar and coolant plates and along the periphery of the manifold holes and are fixed to the bi-polar plates or GDL using a suitable adhesive as described in U.S. Patent No. 6,338,492 B1 and EP 0665984 B1, which are both hereby incorporated by reference. The gaskets may also be formed in the channels or grooves provided on the bi-polar plate, coolant plate, or GDL.

The most common type of sealant used in solid polymer electrolyte fuel cells are gaskets made of silicone rubber, RTV, E-RTV, or like materials. Gaskets of this type are disclosed in WO 02/093672 A2, U.S. Patent No. 6,337,120 and U.S. Patent Application Nos. 20020064703, 20010055708 and 20020068797, which are hereby incorporated by reference.

There are several disadvantages associated with using sealant materials such as silicone rubber, RTV, E-RTV to seal the periphery and manifold areas of the bi-polar plates and coolant plates. Firstly, the sealant material may not be compatible with the plate material used, which may be graphite, graphite composites or metals. Secondly, commonly used sealant materials degrade over time with fuel cell operation. As a result, the sealing action of the gasket is eventually diminished, leading to inter-mixing of gases and liquid. Moreover, it is often difficult to correctly position the gaskets in the grooves or channels provided on the bi-polar plates, coolant plates, or GDLs using conventional manufacturing methods.

There, therefore, remains a need to provide improved seals for bi-polar or coolant plates, and a process for making such seals, which reduces the disadvantages associated with conventional sealing techniques.

The disclosures of all patents/applications referenced herein are incorporated herein by reference.

## SUMMARY OF THE INVENTION

The present invention provides a process for sealing a coolant plate to either an adjacent coolant plate or an adjacent bi-polar plate without

using any external gasket or sealant. The sealing of the plates is accomplished using either vibration welding or resistive welding techniques.

According to one aspect of the invention there is provided a process for sealing a first coolant plate of a fuel cell with an adjacent plate, wherein the first coolant plate comprises at least one mating region for mating with a complementary region on the adjacent plate, wherein the adjacent plate is a second coolant plate or a bipolar plate of a fuel cell, and the first coolant plate and the adjacent plate each comprise a polymer/graphite composition, wherein said process comprises the step of welding said mating region to said complementary region to create a seal between the first coolant plate and the adjacent plate.

In one embodiment of the invention, welding is achieved by resistance welding. In another embodiment of the invention, welding is achieved by vibrational welding.

In a further aspect of the present invention, there is provided a fuel cell component comprising a first coolant plate sealed to an adjacent plate, wherein the first coolant plate comprises at least one mating region for mating with a complementary region on the adjacent plate, the adjacent plate is a second coolant plate or a bipolar plate of a fuel cell, and the first coolant plate and the adjacent plate each comprise a polymer/graphite composition, and wherein said mating region is welded to said complementary region to create the seal.

In another aspect of the invention, a fuel cell is made which has a coolant plate that includes seals prepared by the process of the invention. The seals may be located around the periphery of the coolant plate and/or around the manifold openings.

The preferred embodiments of the present invention can provide many advantages. For example, the use of external seal materials for joining coolant plates may be eliminated. As no external material is used for the seal, there is no problem of material compatibility during sealing and long-term degradation issues are eliminated. The sealed plates can also tolerate higher operating pressures and temperatures. The seal is comprised of the same material as the coolant plate or bi-polar plate, therefore, there is no contamination expected from the seal. The method is cheaper and faster compared to the other conventional sealing processes. The seal can be made immediately after the plate molding

process without handling any adhesive or glue-like materials to form the seal on the plates.

Numerous other objectives, advantages and features of the process will also become apparent to the person skilled in the art upon reading the detailed description of the preferred embodiments, the examples and the claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiments of the present invention will be described with reference to the accompanying drawings in which like numerals refer to the same parts in the several views and in which:

Figure 1a is an exploded perspective view of the membrane electrode assembly;

Figure 1b is an exploded perspective view of a typical polymer electrolyte membrane fuel cell of the prior art, which shows the use of a sealing gasket to prevent leakage from the coolant plates;

Figure 2 is a top view of a coolant plate showing flow field channels;

Figures 3a to 3d are schematic drawings of coolant plates and bi-polar plates made in accordance with a preferred embodiment of the invention; and

Figure 4 is a schematic drawing of a seal created between the coolant plates and bi-polar plates of Figure 3a.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will now be described with reference to the accompanying figures.

The present invention provides a process for sealing coolant plates without using external sealant materials like silicone rubber, RTV, E-RTV, glue etc.

As shown in Figure 1a, a typical polymer electrolyte membrane fuel cell comprises a MEA disposed between two bipolar plates 5. The MEA includes an ion exchange membrane 10 and two gas diffusion layers (GDL) 15. A sealing gasket 17 is adhered between the bi-polar plate 5 and GDL 15 to prevent leakage of fluids from the central part of the MEA, known as the active area (Figure 1b).

The bipolar plates 5 comprise at least one gas flow field with a channel and rib to allow gas or liquid to flow to and from the fuel cell. The bipolar plates 5 are typically bi-polar in construction and may carry either fuel or oxidant on any side of the bi-polar plate 5 depending upon the design of the fuel cell or fuel cell stack.

Where the fuel cell is part of a PEMFC stack and heat needs to be removed from the fuel cell, the fuel cell also includes coolant plates 21. Coolant plates 21 may be introduced at various places within the fuel cell depending on the design of the fuel cell stack. Typically, coolant plates 21 will be located adjacent the bi-polar plates 5 as shown in Figure 1.b. As shown in Figure 2, the coolant plate 21 has flow field channels 23 on either one side or both sides of the coolant plate 21 and manifold holes 42. These flow field channels 23 allow coolant to flow to and from the fuel cell. A sealing gasket 17 is located between the coolant plates 21 and bi-polar plates 5 to prevent leakage of coolant (see Figure 1b).

In a preferred embodiment, the present invention provides a process for sealing coolant plates 21 at the periphery and manifold holes 42. The coolant plate 21 is sealed at its periphery to an adjacent coolant plate 21 or to an adjacent bi-polar plate 5. Sealing is facilitated by the configuration of the coolant plates 21 and bi-polar plates 5. As shown in Figures 3a to 3d, the bi-polar plates 5 and the coolant plates 21 are configured with respective mating ribs 25 and grooves 30. The mating ribs 25 or grooves 30 may be formed on either the bi-polar plate 5 or the coolant plate 21 depending on the fuel cell design. The dimensions of the mating ribs 25 and grooves 30 also vary according to the fuel cell design. The width and height of the mating ribs 25 and grooves 30 are preferably from 0.01 mm to 10 mm, and 0.1 mm to 15 mm, respectively, more preferably from 1.0 mm to 2.0 mm and 1.1 mm to 1.9 mm respectively. In addition, there could be more than one mating rib 25 or groove 30 on each of the bi-polar plate 5 or coolant plate 21.

To create sealing at the periphery of the coolant plate 21, the ribs 25 of the coolant plate 21or bi-polar plate 5 are welded to the complementary grooves 30 of the adjacent coolant plate 21 or bi-polar plate 5 using suitable welding techniques such as resistance welding and vibration welding. However, techniques like ultrasonic welding laser welding, heat lamination, or hot bonding techniques may also be used.

With the vibration welding technique, a vibrational welding machine is used to create a vibrational force amongst and between the coolant plates 21 and bi-polar plates 5 bringing the coolant plates 21 and bi-polar plates 5 together and placing the mating ribs 25 and grooves 30 within close proximity of each other. The vibrational force can be applied to both the bi-polar plate 5 and coolant plate 21, or either one of the plates while keeping the other plate stationary.

As a result of the continued vibrational force on the coolant plates 21 and bipolar plates 5, the contact area between the mating ribs 25 and grooves 30 becomes frictionally engaged, resulting in the production of localized heat which melts the polymer composition of the coolant plates 21 and bi-polar plate 5 at the ribs 25 and grooves 30. When the vibrational force is reduced or is stopped, localized heat production is diminished or eliminated and the coolant plate 21 and bi-polar plate 5 are cooled, solidifying the localized molten polymer composition and fusing the area between the coolant plate 21 and bi-polar plate 5. Pressure is preferably applied to the coolant plate 21 and bi-polar plate 5 during cooling to fuse the molten polymer composition of the coolant plate 21 and bi-polar plate 5 together, creating a permanent seal 40 between the coolant plate 21 and bi-polar plate 5 (see Figure 4). The preferred pressure applied is between about 10 and about 200 psig.

The ribs 25 and grooves 30 of the bi-polar plates 5 and coolant plates 21 are configured so that during vibration of the bi-polar plate 5 and cooling plate 21 only the ribs 25 and grooves 30 are in contact leaving a gap in the central area (usually the flow field channels) 32 of the bi-polar plate 5 and the coolant plate 21. As shown in Figure 4, this configuration allows the ribs 25 to melt during vibration, bringing the central portions (usually the flow field channels) of the bi-polar plates 5 and cooling plates 21 in contact with each other to minimize the resistance losses of the fuel cell stack.

The ability of the ribs 25 and grooves 30 to fuse and seal is related to the amplitude, frequency and timing of the vibrational force applied to the bi-polar plate 5 and coolant plate 21. In a preferred embodiment, the vibrational welding process spans about 3 to about 100 seconds, at a frequency of about 100 to about 500 cycles per second and an amplitude of about 0.5 mm to about 5 mm. It will be apparent to a person skilled in the art that the amplitude, frequency and vibrational timing of the vibrational welding process is designed to complement the sealing action of the polymers within the ribs 25 and grooves 30 and to create minimum contact loss between the bi-polar plates 5 and cooling plates 21.

The sealing action created by the vibrational welding process can be further improved by providing a polymer rich material or pure polymer layer 35 to the ribs 25 or grooves 30 of the bi-polar plates or cooling plates (Figures 3b and 3c).

The bi-polar plates 5 and coolant plates 21 are generally molded from a composition comprising graphite fiber, polymer and graphite powder. The polymer can be any thermoplastic polymer or any other polymer having characteristics similar to a thermoplastic polymer. Preferably the polymer is an aromatic polyester resin such as that available from E.I. du Pont de Nemours and Company under the trademark ZENITE®. The graphite fiber is preferably a pitch-based graphite fiber having a fiber length distribution range from 15 to 500 μm, a fiber diameter of 8 to 15 μm, bulk density of 0.3 to 0.5 g/cm$^3$ and a real density of 2.0 to 2.2 g/cm$^3$. The graphite powder is preferably a synthetic graphite powder with a particle size distribution range of 20 to 1500 μm, a surface area of 2 to 3 m$^2$/g, bulk density of 0.5 to 0.7 g/cm$^3$ and real density of 2.0 to 2.2 g/cm$^3$. Further detail regarding the composition of the bi-polar plates 5 and cooling plates 21 are described in U.S. Patent No. 6,379,795 B1, which is herein incorporated by reference.

The bi-polar plate 5 or coolant plate 21 may therefore be polymer rich at a localized area 35 (see Figures 3b and 3c). In a preferred embodiment, the localized area 35 is 0.002" to 0.100" thick and more preferably 0.020" thick. This localized area 35 comprises between about 25 wt% and about 100 wt% polymer, preferably between about 50 wt% and about 100 wt% polymer, and most preferably about 100 wt% polymer.

The vibrational welding process may also be used to create a seal at the periphery of the manifold holes 42 of the coolant plates 21. While the process remains the same as described above, the coolant plates 21 will be designed in a manner that accommodates the periphery of the manifold holes 42.

Resistive welding may be used to create the seals. The general process for resistance welding is set out in U.S. Patent No. 4,673,450 to Burke, which is hereby incorporated by reference However, its application to fuel cells has not yet been explored.

With the resistance welding process, an alternating or direct current is used to create seals between the ribs 25 and grooves 30 of the bi-polar plate 5 and coolant plate 21. The current is passed between the coolant plate 21 and bi-polar plate 5 bringing the bi-polar plate 5 and coolant plate 21 closer together so that the mating ribs 25 and grooves 30 are in close proximity for sealing. Some pressure may also be applied to the coolant plate 21 and bi-polar plate 5 at the outset to keep the coolant plate 21 and bi-polar plate 5 together.

As current flows through the bi-polar plate 5 and coolant plate 21, the contact area between the mating ribs 25 and grooves 30 of the bi-polar plate 5 and cooling plate 21 experience a relatively higher resistance, thereby resulting in the production of localized heat at the ribs 25 and grooves 30. This localized heat melts the polymer component of the bi-polar plate 5 and coolant plate 21 at the ribs 25 and grooves 30. At this point, the flow of current is stopped while pressure is applied to the bi-polar plate 5 and coolant plate 21 to fuse the melted portion of the bi-polar plate 5 and coolant plate 21 together. Localized heat production stops when the current is withdrawn and the temperature of the bi-polar plate 5 and coolant plate 21 at the ribs 25 and grooves 30 drops quickly to a temperature of about 140°C which is well below the glass transition temperature of the polymer (about 220°C). As a result the fused area between the bi-polar plate and coolant plate, is solidified creating a permanent seal 40 (see Figure 4).

The bi-polar plate 5 and coolant plate 21 can be designed so that these plates can be used as electrodes to supply current directly, thereby eliminating the need to use separate electrodes to flow current.

The ribs 25 and grooves 30 of the bi-polar plates 5 and coolant plates 21 are configured so that during the flow of current through the bi-polar plate 5 and coolant plate 21 only the ribs 25 and grooves 30 are in contact, leaving a gap in the central area (usually the flow field channels) of the bi-polar plate 5 and the coolant plate 21. This configuration allows the ribs 25 to melt during current flow bringing the central portions (usually the flow field channels) of the bi-polar plates 5 and cooling plates 21 in contact with each other to minimize the resistance losses of the fuel cell stack.

The magnitude of the alternating current and applied pressure and the duration of the current flow is chosen to complement the sealing action of the polymer within the ribs 25 and grooves 30 and depends on the sealing surface area of the plate. The amperage, voltage, design pressure and span of current flow will vary depending on the welding surface area and the degree of melting at the ribs 25 and grooves 30. However, in a preferred embodiment, the applied current is between about 0.1 amperes/mm$^2$ and about 3 amperes/mm$^2$, preferably between about 0.8 and about 1.1 amperes/mm$^2$ and its voltage is about 5 to about 25 volts, and the resistance welding process spans about 2 to about

100 seconds. The applied pressure is preferably between about 50 and about 100 psig.

The resistance welding process may also be used to create seals at the periphery of the manifold holes 42 of the coolant plates 21. While the process remains the same as described above, the coolant plates 21 will be designed in a manner that accommodates the periphery of the manifold holes 42.

It will be apparent to one skilled in the art that the seal and process for sealing provided by the present invention has many applications. It can be used to join a bi-polar plate 5 and coolant plate 21 to form a seal around the external periphery or around the manifold holes 42 of a the coolant plate 21. The vibration welding and resistance welding processes can also be used to form a seal around the periphery and manifold areas of the metal plates used for PEMFC stacks. It is also not limited to PEMFC fuel cell stacks, but can also be extended to direct methanol fuel cells (DMFC) and phosphoric acid fuel cells where heat needs to be dissipated using a coolant flow field plate.

The following examples illustrate the various advantages of the preferred method of the present invention.

## EXAMPLES

Example 1 - Vibration Welding:

The strength of sealing was tested by joining two manufactured parts (composite plaques) comprising 25% Zenite®800, 55% Thermocarb® graphite powder and 20% graphite fibre. The parts have a length of 60.9 mm, width of 17.5 mm and a thickness of 3.4 mm.

The parts were welded together using a Branson Mini II vibrational welding machine. The parts were heated to 160 °C and then placed in the vibrational welding machine, which had been preset at 1.78 mm amplitude, 1.5 mm melt down and 1.0 Mpa pressure. The parts were welded at both Butt and T positions. The strength of the welded joint was measured and tabulated in Table 1.

Table 1: Weld Strength Measurements

| Weld Strength Test | Strength of Weld (MPa) |
|---|---|
| T-weld strength | 1.69 |
| Jason max strength | 31.21 |
| Jason average strength | 25.30 |
| Jason minimum strength | 20.59 |

Example 2 - Resistance Welding:

Two composite parts comprising 25% Zenite®800, 55% Thermocarb® graphite powder and 20% graphite fiber were welded using the resistance welding process. The parts had a length of 60.9 mm, a width of 17.5 mm and a thickness of 3.4 mm in size.

A jig was made to apply a direct current through two electrodes attached directly to each part. A welding machine was used as a power source. The jig also applied and controlled the pressure on the composite parts. A gas cylinder was used as the source of pressure.

The two composite parts were placed in the jig (for Butt welding position) and an 80-ampere (80 A) current was passed through the parts for approximately 2.52 seconds. 2 psig pressure was applied to the plates during the melt down process (Test Parts 1).

The weld strength of the welded joint was measured and compared with other samples in which the current, pressure or time of welding was changed. When the welding time was reduced to 1.91 seconds, the weld strength increased to 4.01 MPa (Test Parts 2). In another experiment, an increase in weld strength to 6.78 MPa was observed when current flow was reduced from 80 A to 70 A but the weld time increased to 4.03 seconds (Test Parts 3). The possible reason for the increase in weld strength is due to the slower polymer degradation at lower weld current - at higher current (80 A), the polymer is likely to degrade faster than at the lower current (70 A). The weld strength of Test Parts 4 was also measured using 90 A current for 4.25 seconds. Table 2 provides a comparison of the weld strength test using the various parameters.

Table 2: Summary of Weld Strength Results Using Resistance

| Test Parameters | Test Parts 1 | Test Parts 2 | Test Parts 3 | Test Parts 4 |
|---|---|---|---|---|
| Current (A) | 80 | 80 | 70 | 90 |
| Pressure (psig) | 2 | 2 | 2 | 3.5 |
| Maximum Weld Time (sec) | 2.52 | 1.91 | 4.03 | 4.25 |
| Meltdown (mm) | 1.84 | 1.84 | 1.84 | 1.45 |
| Maximum weld strength, MPa | 1.12 | 4.01 | 6.78 | 3.42 |

Although the present invention has been shown and described with respect to its preferred embodiments and in the examples, it will be understood by those skilled in the art that other changes, modifications, additions and omissions may be made without departing from the substance and the scope of the present invention as defined by the attached claims.

## CLAIMS

What is claimed is:

1. A process for sealing a first coolant plate of a fuel cell with an adjacent plate, wherein the first coolant plate comprises at least one mating region for mating with a complementary region on the adjacent plate, wherein the adjacent plate is a second coolant plate or a bipolar plate of a fuel cell, and the first coolant plate and the adjacent plate each comprise a polymer/graphite composition, wherein said process comprises the step of welding said mating region to said complementary region to create a seal between the first coolant plate and the adjacent plate.

2. The process of Claim 1 wherein the polymer/graphite composition of said first coolant plate and adjacent plate comprise graphite fiber, polymer and graphite powder.

3. The process of Claims 1 or 2 wherein the welding step is selected from the group consisting of resistance welding, vibrational welding, ultrasonic welding, laser welding, heat lamination, and hot bonding techniques.

4. The process of Claim 3 wherein the welding step is resistance welding.

5. The process of Claim 4 wherein the resistance welding comprises the steps of:

(a) placing the mating region and complementary region in close proximity to each other;

(b) applying an electrical current between the first coolant plate and the adjacent plate to produce localized heat at the mating region and complementary region sufficient to melt the polymer of the first coolant plate and the adjacent plate at the mating region and complementary region; and

(c) ceasing to apply the current and applying pressure to the first coolant plate and the adjacent plate to allow the melted polymer to cool and to create a seal at the mating region and complementary region.

6. The process of Claim 5 wherein the electrical current is between about 0.1 amperes/mm$^2$ and about 3 amperes/mm$^2$, preferably between about 0.8 and about 1.1 amperes/mm$^2$, its voltage is between about 5 and about 25 volts and the current is applied over about 2 to about 100 seconds.

7. The process of Claims 5 or 6 wherein the pressure applied is between about 50 and about 200 psig.

8. The process of any one of Claims 5 to 7 wherein the electrical current is applied using either external electrodes or the plates themselves.

9. The process of any one of Claims 1 to 8 wherein the mating region and complementary region comprise a rib and a groove.

10. The process of Claim 3 wherein the welding step is vibration welding.

11, The process of Claim 10 wherein the vibration welding comprises the steps of:

(a) placing the mating region and complementary region in close proximity to each other;

(b) applying a vibrational force between the first coolant plate and the adjacent plate to produce localized heat at the mating region and complementary region sufficient to melt the polymer of the first coolant plate and the adjacent plate at the mating region and complementary region; and

(c) ceasing to apply the vibrational force and applying pressure to the first coolant plate and the adjacent plate to allow the melted polymer to cool and to create a seal at the mating region and complementary region.

12. The process of Claim 11 wherein the vibrational force is applied at a frequency of between about 100 and about 500 cycles per second over a time period between about 3 and about 100 seconds at an amplitude of between about 0.5 and about 5 mm.

13. The process of Claims 10 or 11 wherein the pressure applied is between about 50 and about 200 psig.

14. The process of any one of Claims 9 to 12 wherein said mating region comprises a rib and said complementary region comprises a groove.

15. The process of Claim 14 wherein one of the first coolant plate and the adjacent plate comprise a polymer rich outer layer on the rib or groove.

16. The process of Claim 15 wherein the polymer rich outer layer comprises between about 25 wt % and about 100 wt % polymer, preferably between about 50 wt % and about 100 wt % polymer, and most preferably about 100 wt % polymer.

17. A fuel cell comprising a first coolant plate and an adjacent plate, wherein the first coolant plate is sealed to the adjacent plate using the process of any one of Claims 1 to 16.

18. A fuel cell component comprising a first coolant plate sealed to an adjacent plate, wherein the first coolant plate comprises at least one mating region for mating with a complementary region on the adjacent plate, the adjacent plate is a second coolant plate or a bipolar plate of a fuel cell, and the first coolant plate and the adjacent plate each comprise a polymer/graphite composition, and wherein said mating region is welded to said complementary region to create the seal.

19. The fuel cell component of Claim 18 wherein the polymer/graphite composition of said first coolant plate and adjacent plate comprise graphite fiber, polymer and graphite powder.

20. The fuel cell component of Claims 18 or 19 wherein the mating region and complementary region comprise a rib and a groove.

21. The fuel cell component of Claim 20 wherein one of the first coolant plate and the adjacent plate comprise a polymer rich outer layer on the rib or groove.

22. The fuel cell component of Claim 21 wherein the polymer rich outer layer comprises between about 25 wt % and about 100 wt % polymer, preferably between about 50 wt % and about 100 wt % polymer, and most preferably about 100 wt % polymer.

23. A fuel cell comprising the fuel cell component of any one of Claims 18-22.

24. A fuel cell stack comprises a plurality of the fuel cells of Claims 17 and 23.

TITLE

# PROCESS FOR SEALING PLATES IN A FUEL CELL

ABSTRACT:

There is provided a process for sealing a coolant plate to an adjacent bi-polar plate or coolant plate in a fuel cell. The process comprises the step of welding a mating region and complementary region of the plates together using resistance welding or vibration welding processes.

DPF/dmm

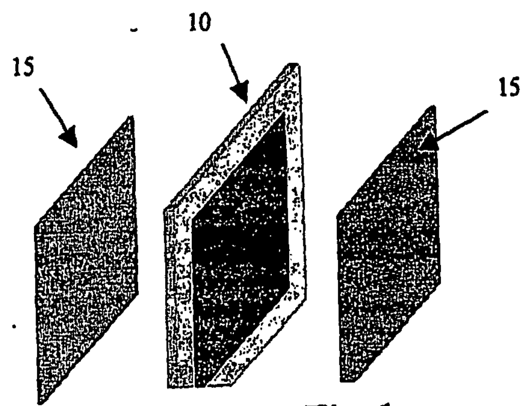



Fig. 1a

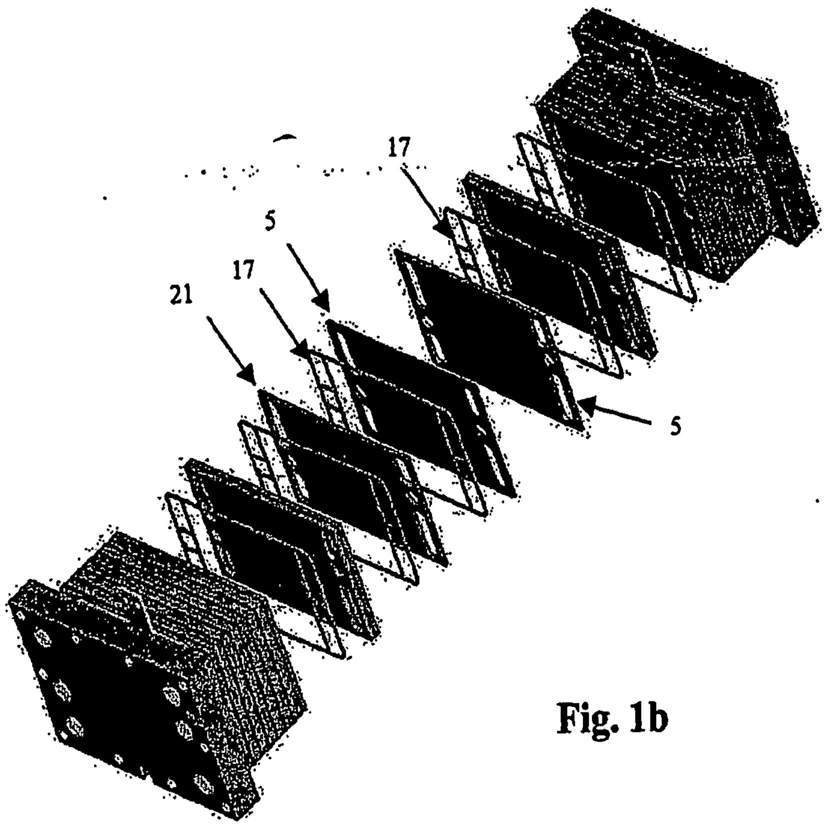



Fig. 1b

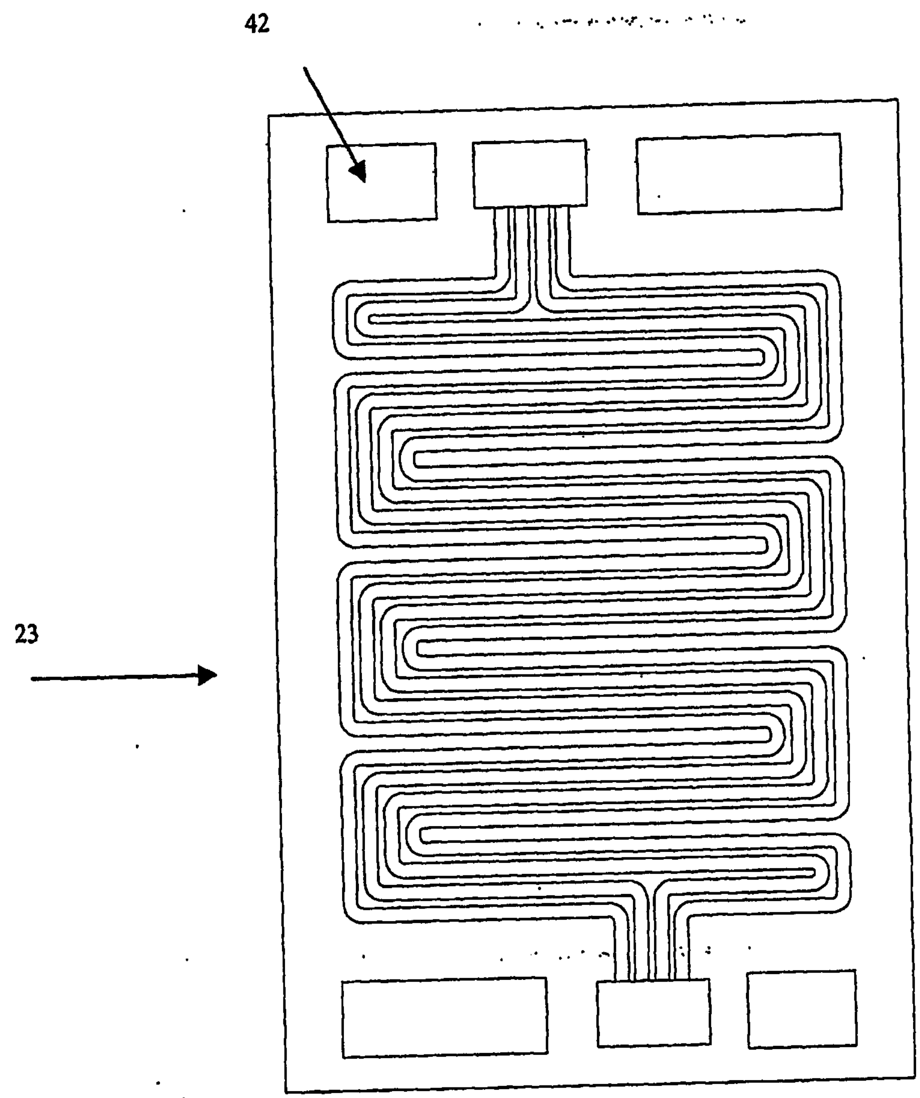



Fig. 2

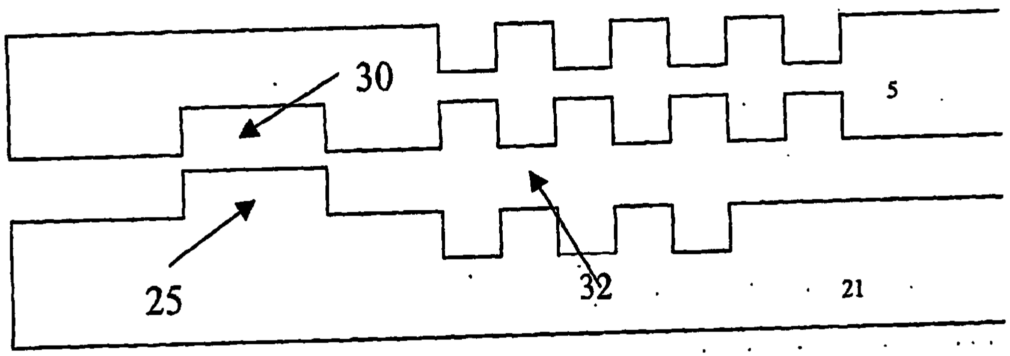
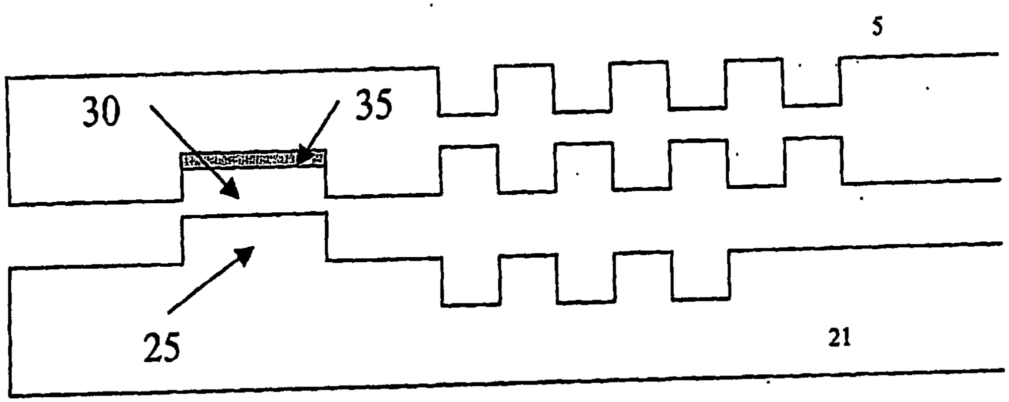



Fig. 3a



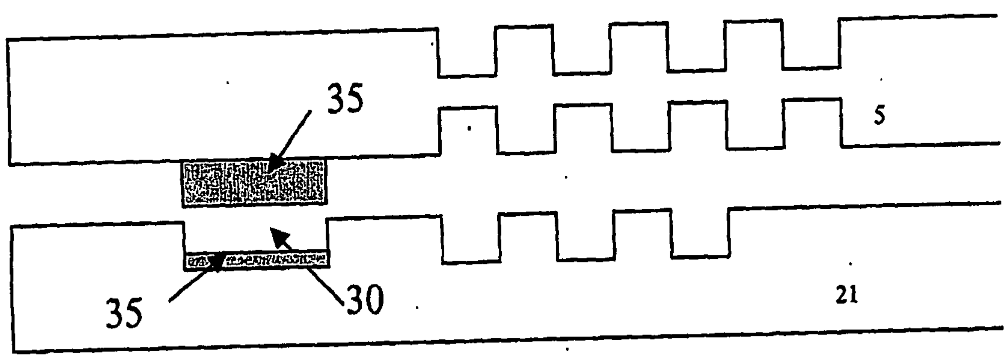



Fig. 3c

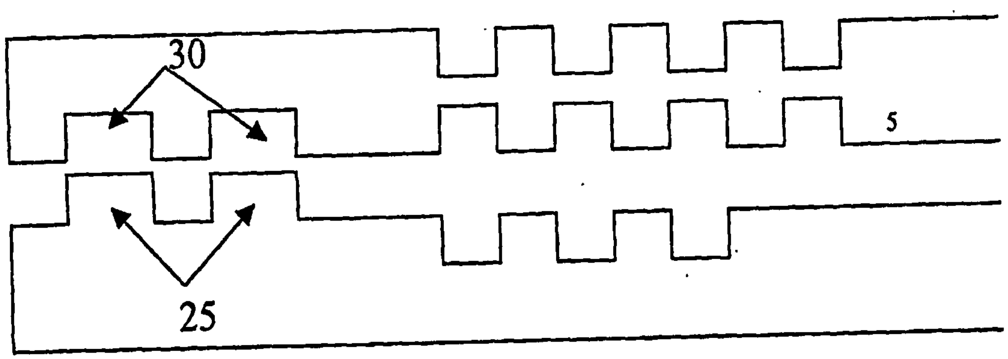



Fig. 3d

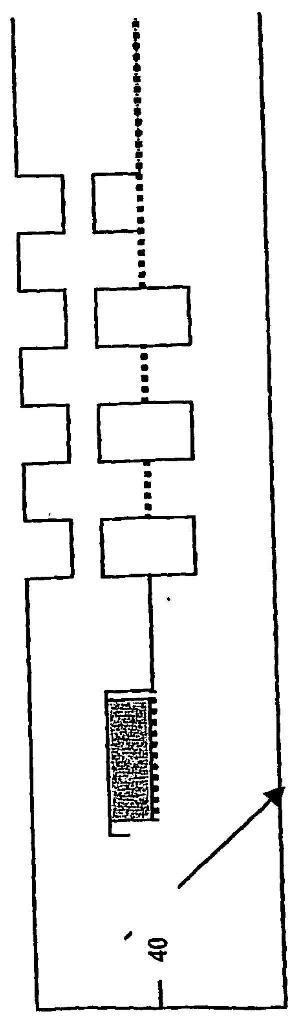



Fig. 4.0